Space Technology Research Grants

Development of 2D and 3D transient electro-thermal computational models to predict the radiation failures in SiC-based Schottky diodes and power field-effect transistors (FETs)

Completed Technology Project (2017 - 2019)

Project Introduction

High voltage (HV) power devices based on silicon carbide (SiC) semiconductor material may offer revolutionary transformations for future NASA space missions, due to the roughly three-fold increase in bandgap of SiC-based devices over traditional silicon (Si)-based devices. The wide bandgap feature enables the SiC device to operate at higher voltages, temperatures, and switching frequencies with greater efficiencies compared to existing Si devices. However, the unique space environment presents a great challenge to the device performance and reliability. To safely deploy SiC power devices for space missions, one has to first answer the question of how SiC-devices survive from the harsh radiation environment in space. Fundamental research into the radiation susceptibility and failure mechanisms of SiC is necessary. The overall goal of the proposed project is to advance the understanding of radiation failure mechanism in silicon carbide (SiC) materials for power devices, and provide the guidelines to design and fabricate SiC-based devices with higher resistance to radiation single-event effects (SEEs).

Anticipated Benefits

The overall goal of the proposed project is to advance the understanding of radiation failure mechanism in silicon carbide (SiC) materials for power devices, and provide the guidelines to design and fabricate SiC-based devices with higher resistance to radiation single-event effects (SEEs). High voltage (HV) power devices based on silicon carbide (SiC) semiconductor material may offer revolutionary transformations for future NASA space missions, due to the roughly three-fold increase in bandgap of SiC-based devices over traditional silicon (Si)-based devices.

Development of 2D and 3D transient electro-thermal computational models to predict the radiation failures in SiC-based Schottky diodes and power field-effect transistors

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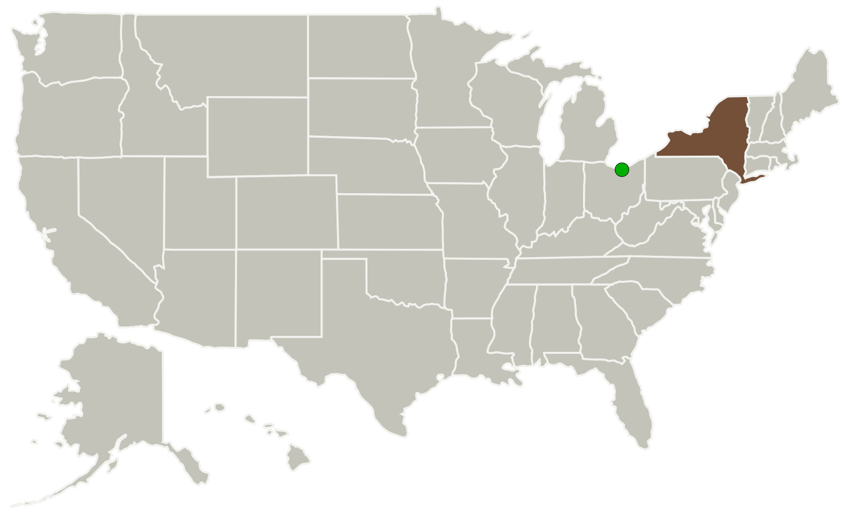
Completed Technology Project (2017 - 2019)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Rensselaer Polytechnic Institute	Lead Organization	Academia	Troy, New York
General Electric Company	Supporting Organization	Industry	Niskayuna, New York
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations
New York

Project Website:

https://www.nasa.gov/strg#.VQb6T0jJzyE

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Rensselaer Polytechnic Institute

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

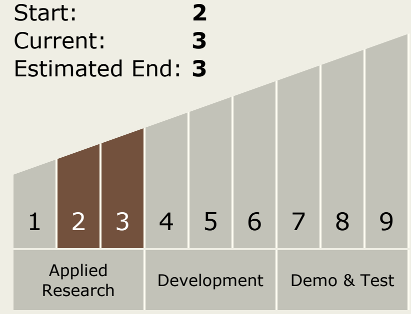
Hung D Nguyen

Principal Investigator:

Wei Ji

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX13 Ground, Test, and Surface Systems
  └ TX13.2 Test and Qualification
    └ TX13.2.2 Propulsion, Exhaust, and Propellant Management

Target Destination

Outside the Solar System